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Arrangement for sensing a frontal impact of a motor vehicle

The invention relates to an arrangement for sensing a frontal impact of a motor vehicle of the type defined in more detail in the preamble of patent claim 1.

In modern motor vehicles, numerous active and passive safety devices are used to reduce the consequences of an accident for a vehicle occupant and, if appropriate, another party involved in the accident, for example a pedestrian. In order to trigger such safety devices such as, for example, restraint means in the form of seatbelt pretensioners, airbags etc. or in order to raise the engine hood in order to protect a pedestrian, the prior art provides both mechanical and electrical sensors which differentiate a crash situation from normal driving conditions mainly on the basis of deformation or acceleration.

The sensors which are installed on the vehicle can be provided in order to actuate preventative measures which are taken before an accident, and acute measures which are taken after an accident has been detected, it being possible in this context to differentiate the type of impact, such as for example a frontal impact or a side impact.

DE 2 212 90 discloses a collision sensor for activating a restraint device for vehicle occupants in vehicles in the event of accident-related deceleration of the vehicle. This known collision sensor is embodied as a contact strip made of an elastic material which is arranged on an external part of the vehicle, at least two contact elements, which lie opposite one another in an at least approximately horizontal plane, being

embedded in the elastic material. There is provision here that in the event of an impact of the vehicle first the contact element which lies further on the outside comes into contact with the other party in the accident and is pressed against the corresponding contact element which lies on the inside. The relative speed of the parties in the accident is calculated from the distance between the two contact elements and the difference in time between the impulse on the first contact element and the impulse on the second contact element, and when a predefined value is exceeded a restraint system is triggered.

A disadvantage with this known collision sensor is that the other party in the accident must firstly travel a specific distance in the elastic embedding material in order to come into contact with the first, external contact element, in which case however both the first and the second contact element are displaced as a result of displacement of the elastic embedding material.

The deformation of the contact strip thus does not provide a reliable measured section for measuring time. In addition, the result of the measurement of time is highly temperature-dependent.

Determination of the difference in speed between the parties in the accident is consequently subject to uncertainties which can have adverse effects on the rapidity of the triggering of the safety devices.

The object of the present invention is therefore to provide an arrangement for sensing a frontal impact of a vehicle which permits safety systems to be triggered quickly and in a way which is appropriate for the situation when the motor vehicle is involved in an accident.

According to the invention this object is achieved with an arrangement for sensing a front impact according to the characterizing features of patent claim 1.

An arrangement for sensing a front impact of a motor vehicle, in which a plurality of impact sensors which are connected to a control device are integrated into a bumper of the motor vehicle and the impact sensors comprise first contact sensor elements which face the front of the vehicle, and second contact sensor elements which face away from the front of the vehicle, which are arranged spaced apart from one another and which constitute units which are respectively separate from one another and between which a free cavity which forms a measured section is provided, permits more precise acceleration signals or speed signals to be generated at a very early time in the crash sequence when a vehicle impact occurs at a front part of the front or a front part of the rear of a motor vehicle since when force acts on the contact sensor element which faces the front of the vehicle, the contact sensor element which faces away from the front of the vehicle is not displaced or the measured section is changed in some other way.

The invention thus permits the fastest possible triggering of the respectively provided safety devices in a way which is adapted to the situation and with a high degree of resolution quality, for example owing to the relative speed with respect to the other party in the collision and an accident severity value which is derived therefrom if appropriate.

In one advantageous embodiment of the invention in particular in terms of improved protection for pedestrians, it is possible to provide for the cavity which forms the measured section to be surrounded by a

foam-like shaped element, thus providing damping when the vehicle impacts against a pedestrian.

Further advantages and advantageous refinements of the subject matter according to the invention can be found in the patent claims, the description and the drawing.

Two exemplary embodiments of an arrangement according to the invention for sensing a frontal impact of a motor vehicle are illustrated in more detail in the drawing and explained in more detail in the following description. In said drawing:

Figure 1 is a basic sketch with a schematic plan view of a motor vehicle and a simplified block diagram of an arrangement according to the invention for sensing a frontal impact of the motor vehicle;

Figure 2 is a first embodiment variant of an arrangement of contact sensor elements of an impact sensor on a bumper in a schematic cross section; and

Figure 3 is a simplified cross section through a second embodiment variant of an arrangement of contact sensor elements of an impact sensor on a bumper.

As is apparent from figure 1, a motor vehicle 1, which may be a passenger car or a utility vehicle, has a sensor safety system 2 which comprises a control device 3, an impact sensor system 4, a driving situation data detection unit 5 with a vehicle state sensor system 6, a device 7 for detecting the surroundings of the vehicle and a passenger compartment sensor system 8. The safety sensor system 2 of the motor vehicle 1 is applied here in different stages as a function of the

danger level or severity of the accident for the motor vehicle 1.

In the embodiment shown, the impact sensor system 4 comprises a central sensor device 9 which is connected to the control device 3 and which constitutes what is referred to as a crash sensor and determines accelerations both in the x direction and in the y direction, that is to say in the longitudinal direction of the vehicle and the lateral direction of the vehicle, and thus detects a frontal impact or a side impact.

In addition to this central sensor device 9, decentralized impact sensors 10 are provided on a bumper 13 on the front part of the front 12 of the vehicle by means of which, when a vehicle impact occurs, an acceleration signal can be generated in the longitudinal direction of the vehicle, and a speed signal can be generated.

In the present case, a plurality of decentralized impact sensors 10 which form respectively separate units in terms of their arrangement on the bumper 13 are shown on the front part of the front 12 of the vehicle merely by way of example but any desired number of impact sensors can be provided with a very different distribution, for example at a distance of approximately 10 cm, either on the front part of the front 12 of the vehicle or on a front part 14 of the rear of the vehicle.

As shown in more detail in figure 2 and figure 3, the impact sensors 10 are each embodied with first contact sensor elements 15 which face the front 12 of the vehicle, and second contact sensor elements 16 which face away from the front 12 of the vehicle which elements 15 and 16 are spaced apart from one another

essentially in the longitudinal direction of the vehicle and by means of which, when a vehicle impact occurs, an acceleration signal or speed signal can be generated.

The impact sensors 10 which are embodied here as relative speed sensors determine a deformation acceleration when an impact of the motor vehicle 1 occurs in the longitudinal direction of the vehicle, and preferably have a signal processing means which amplifies and digitizes the acceleration signals. Numerical integration of the acceleration signal, which can be carried out by a processor of the control device 3, provides the deformation speed of the frontmost structural region of the motor vehicle 1. From this speed information it is in turn possible to infer the severity of the accident if, for example, classes for the severity of an accident are assigned in each case to a defined threshold for the acceleration signal and the speed signal.

If the acceleration signal or the speed signal exceeds such a predefined threshold, a triggering signal which is appropriate for the accident situation is output according to a triggering algorithm stored in the control device 3 in order to activate safety devices 17 which can comprise vehicle-occupant restraint devices 18 such as, for example, airbags, seatbelts with seatbelt pretensioners, displaceable impact bodies, cushions and headrests, whose size, hardness, shape and position can be changed by an actuating process, an electric seat adjustment means, a headrest adjustment means or the like, or else pedestrian protection devices 19, such as an engine hood raising device or an external airbag.

The selection of the activated safety devices is tailored to the thresholds which are exceeded by an

acceleration signal or a speed signal of the impact sensors 10 and the central sensor device 19, a threshold of the central sensor device 9 being lowered if a high relative speed or collision speed is determined by the impact sensors 10. On the other hand, a low speed accident, designated also a "soft crash", in which none of the safety devices 17 is triggered, can be detected below a minimum threshold of the relative speed or acceleration.

Referring to figure 2 and figure 3, the design of the impact sensors 10 is illustrated in more detail, it being apparent that the first, external contact sensor elements 15 and second, internal contact sensor elements 16 constitute units which are respectively separate from one another and between which a free cavity 18 which forms a measured section is provided.

In the embodiment according to figure 2, the cavity 18 which forms the measured section and which the external contact sensor element 15 passes through in the direction of the second contact sensor element 16 in the event of a crash is surrounded by a foam-like shaped element 19.

The contact sensor element 15, lying on the outside, of the impact sensor 10 is secured to an outer skin 10 of the bumper 13 and is essentially in the form of a cylindrical plunger here which is embodied in a tapering fashion in the direction of the second contact sensor element 16 for the sake of better mobility in the event of a crash.

The contact sensor element 16 which lies on the inside is arranged on the highly stable, front crossmember 11 of the motor vehicle and is embodied here as an essentially circular stop.

The impact sensors 10 are preferably embodied as piezo-electric sensors or a force-dependent resistor or FSR sensors, but other suitable types of sensors, such as optical waveguides, can also be applied.

These impact sensors 10 are used to measure a time difference between a first impulse against the respective contact sensor element 15, lying on the outside, and a second impulse against the respective contact sensor element 16, lying on the inside, in order to generate the speed signal. In this context, when an impulse is applied, the contact sensor elements 15, 16 output, to the control device 3, a voltage signal or a change in resistance, which correlate with a contact force which exerts the impulse, said control device in turn outputting an activation signal to safety devices 17 of the motor vehicle 1 as a function of whether the speed signal exceeds a predefined threshold.

The embodiment shown in figure 3 differs from the embodiment according to figure 2 in that the impact sensors 10 are integrated into a hollow strip 21 which is attached to the front side of the bumper 13 or embodied in one piece therewith and which extends at least partially along the width of the vehicle. In this context, the first contact sensor element 15 which is on the front side of the vehicle is arranged on a front wall 22 of the hollow strip 21, and the second contact sensor element 16, lying on the inside, is arranged on the front outer skin 20 of the bumper 13.

Of course, in this embodiment the measured section 18 can also be formed between the first contact sensor element 15 which starts the measurement and the second contact sensor element 16 which stops the measurement, in the hollowing strip 21 within a foam-like shaped part.